



Parabolic Trough Solar Technology for Utility Power Markets in the Southwestern United States

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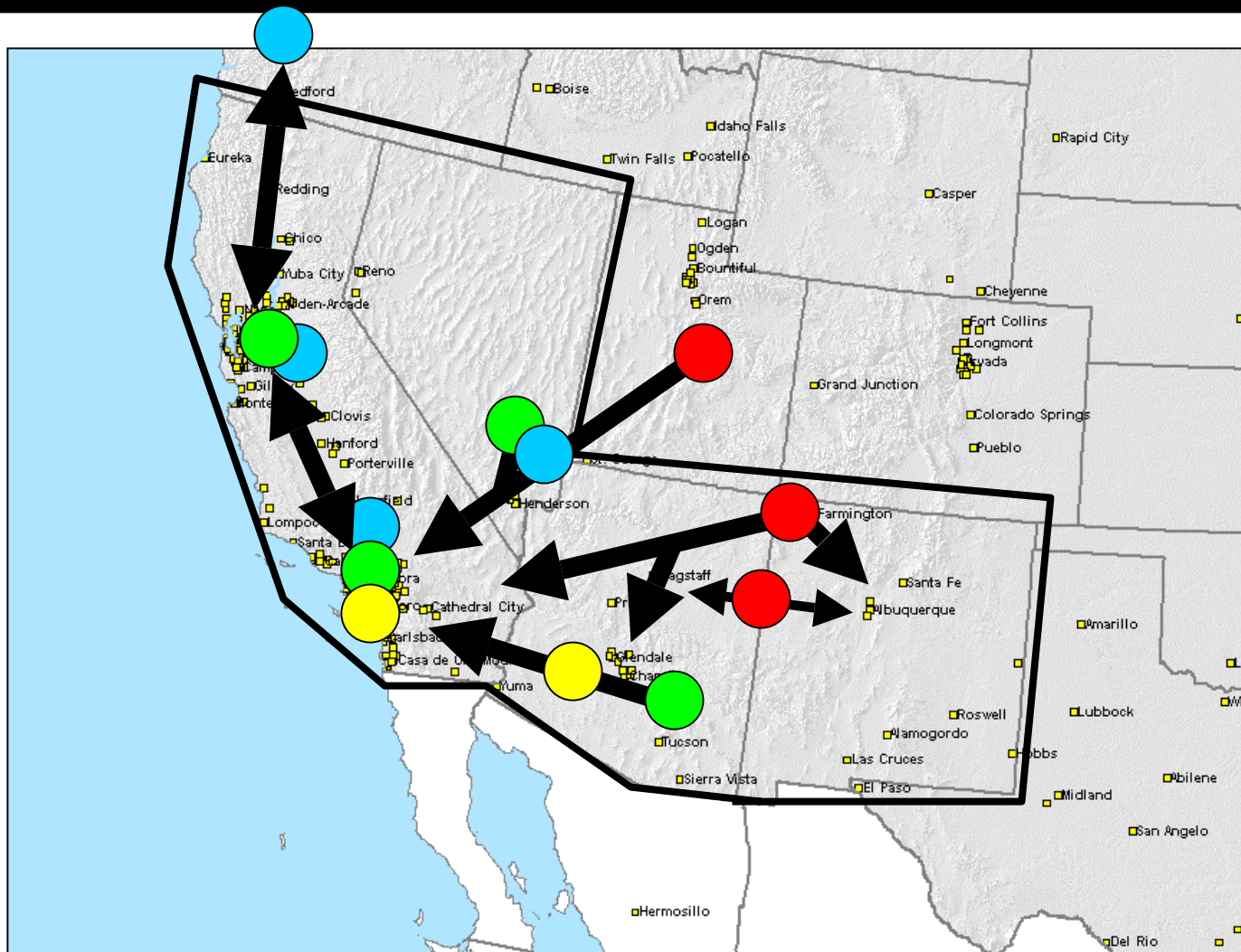
- **US Southwest Power Market**
- **Cost of Electricity from Conventional Sources**
- **How Solar Power Fits with the Grid**
- **Cost of Solar Electricity**



U.S. Department of Energy
Energy Efficiency and Renewable Energy

Southwest Market Overview

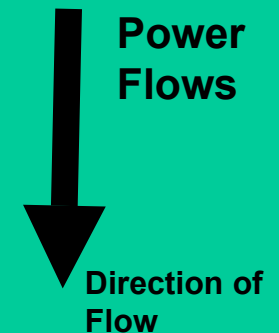
Generation & Transmission



Generation

- Hydro
- Coal
- Nuclear
- Gas

Transmission

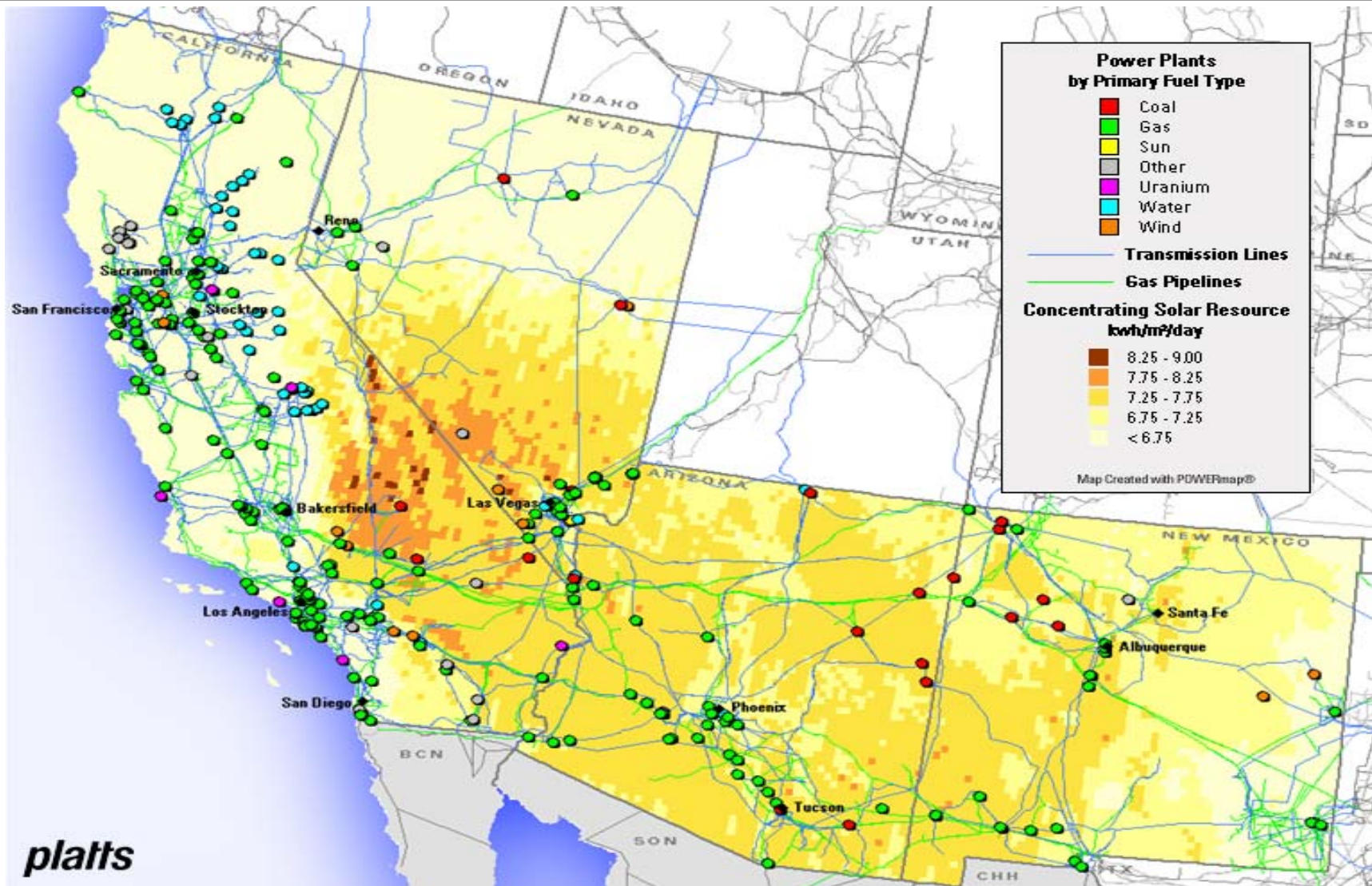




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Southwest Market Overview

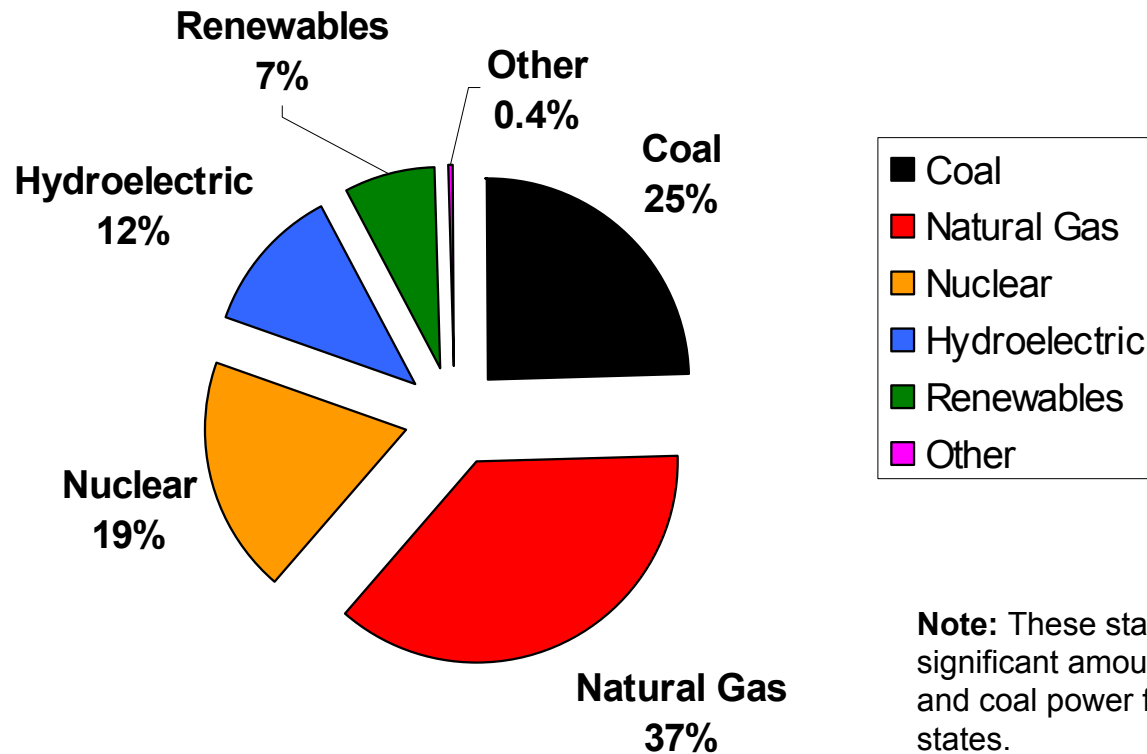
Abundant Solar Resources





Southwestern U.S. Electric Generation

2002 Electric Generation by Primary Energy Source (billion kWh) (Arizona, California, Nevada, New Mexico)



Note: These states also import a significant amount of hydroelectric and coal power from surrounding states.

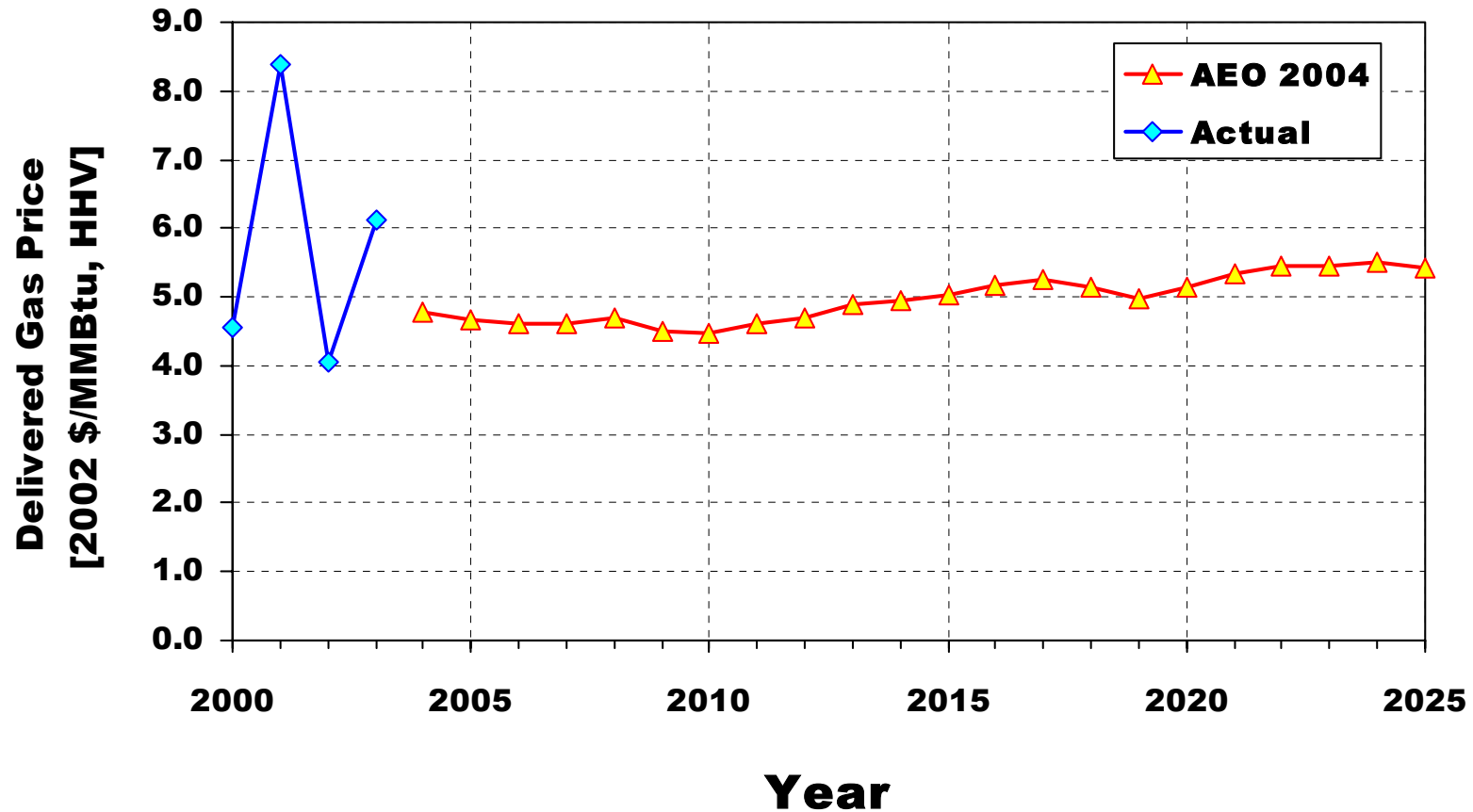


Conventional Sources of Electric Generation

Nuclear	No new nuclear power plants are currently being developed
Hydroelectric	Environmental considerations preclude future development
Coal	Environmental and siting considerations make it very difficult to build coal plants near existing population centers, constrained transmission
Natural Gas	Constrained supply, price volatility and increasing cost



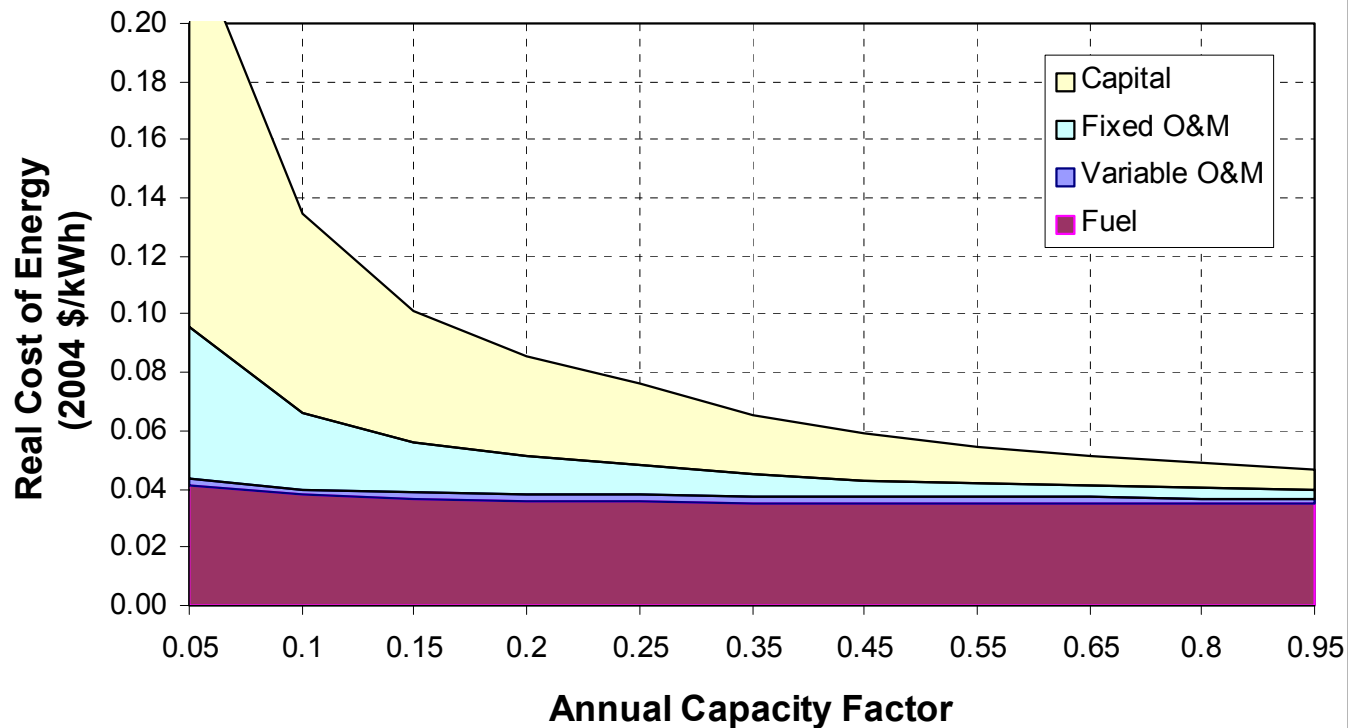
Natural Gas Price Forecast Pacific Region





Cost of Electricity Advanced Combined-Cycle

EIA AEO2004: Pacific Region Electric Costs
Advanced Combined Cycle



Energy = \$0.037/kWh

Fuel + Variable O&M

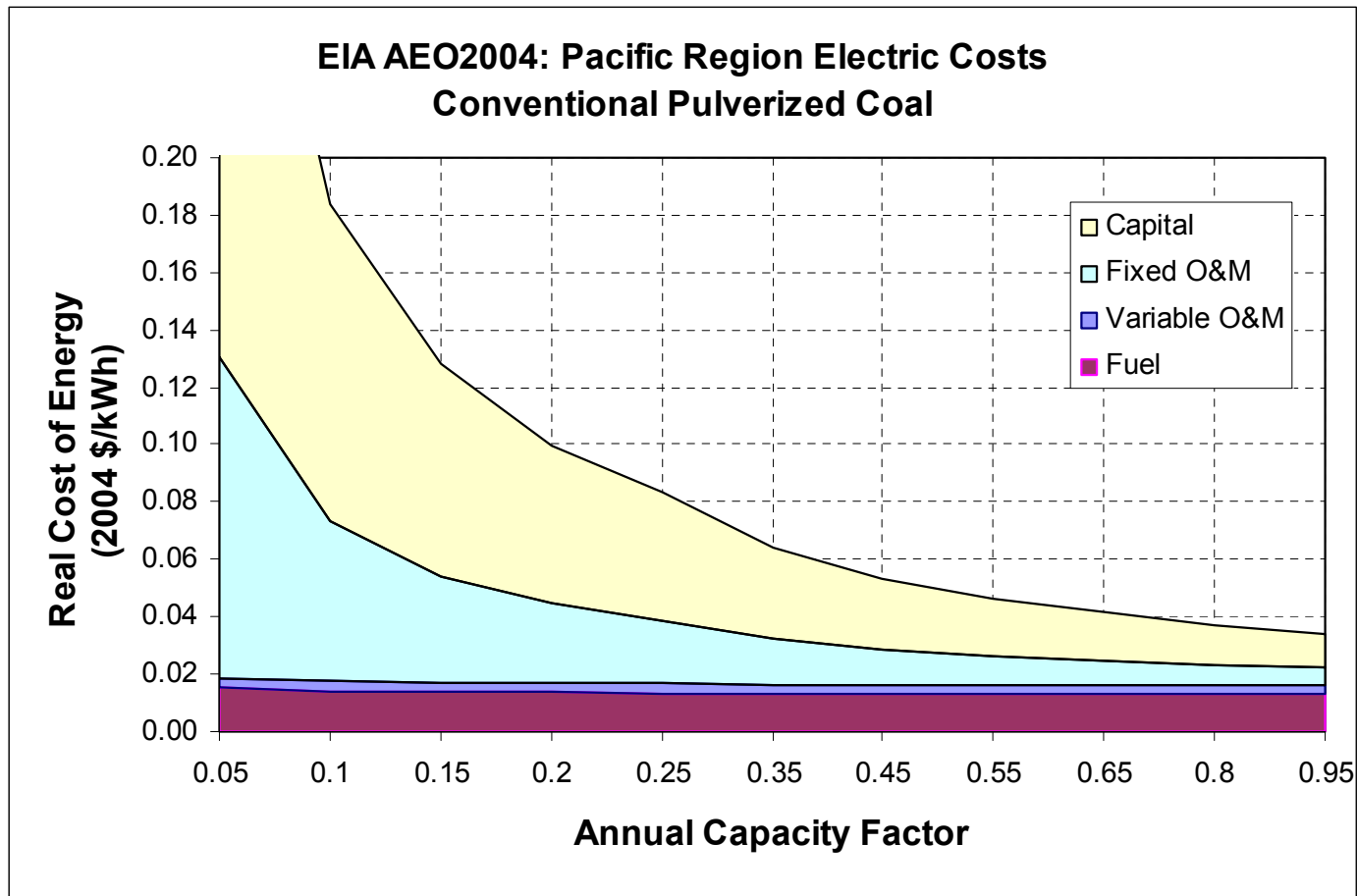
Capacity = \$84/kW-yr

Capital + Fixed O&M



Cost of Electricity

Conventional Pulverized Coal



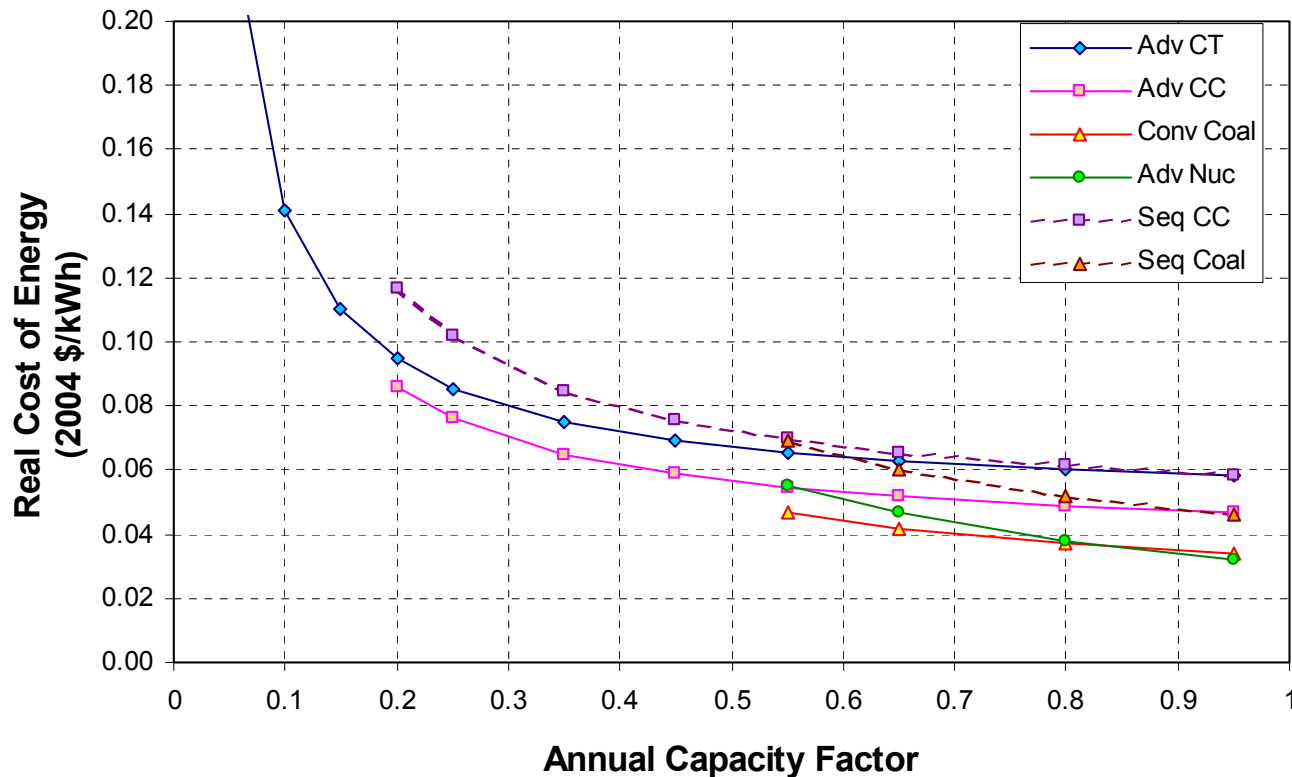
Energy = \$0.017/kWh
Fuel + Variable O&M

Capacity = \$146/kW-yr
Capital + Fixed O&M



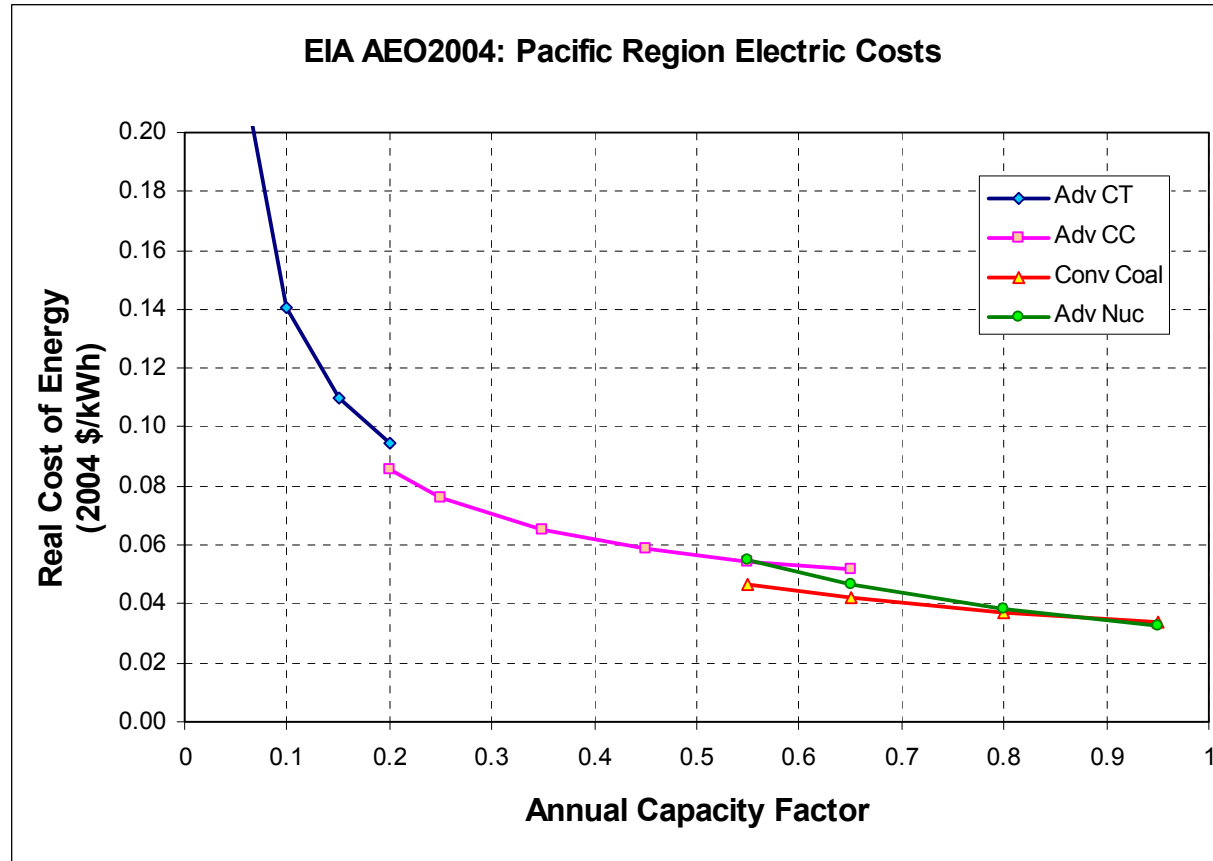
Comparison of Electric Generation Costs

EIA AEO2004: Pacific Region Electric Costs



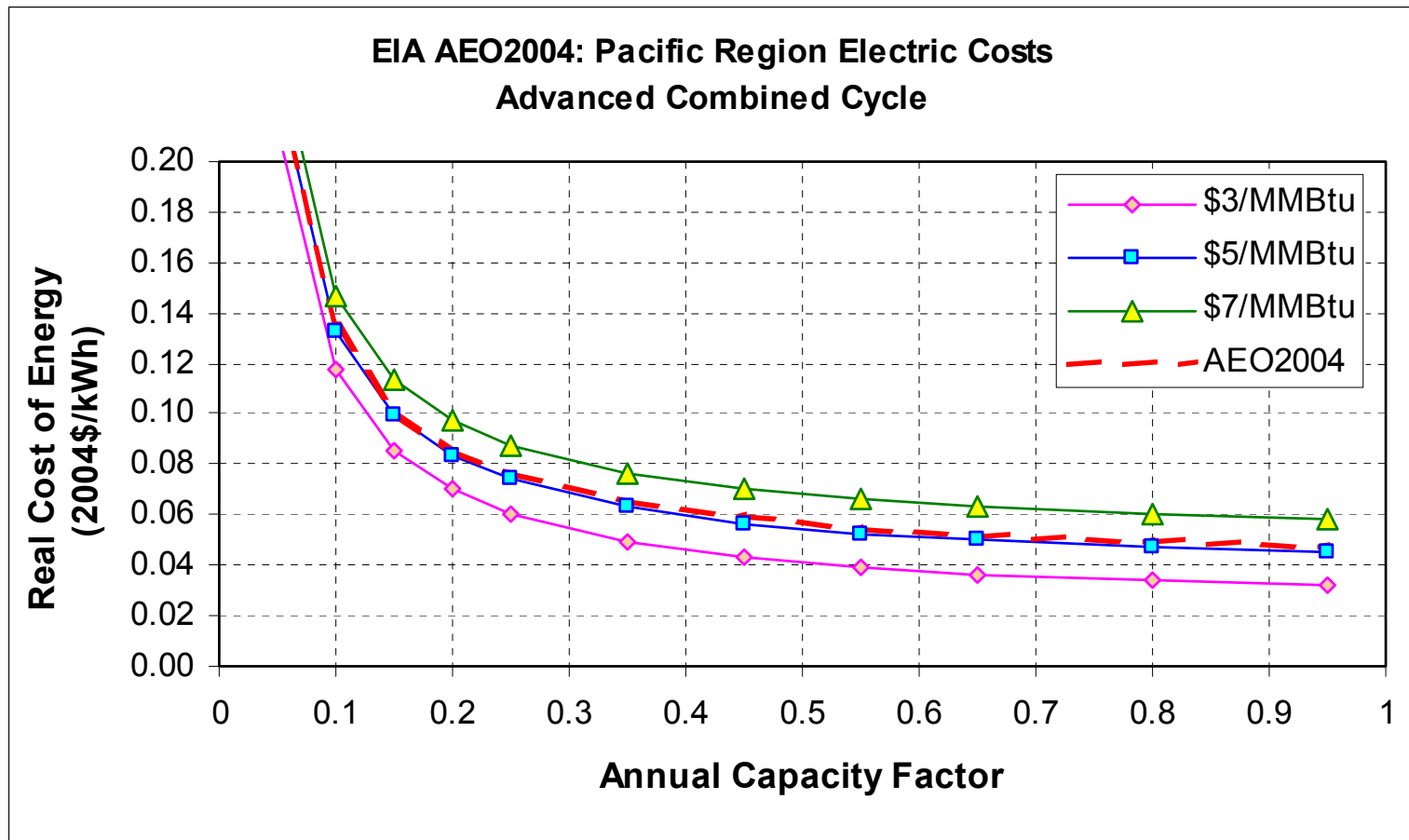


Minimum Cost Generation Source



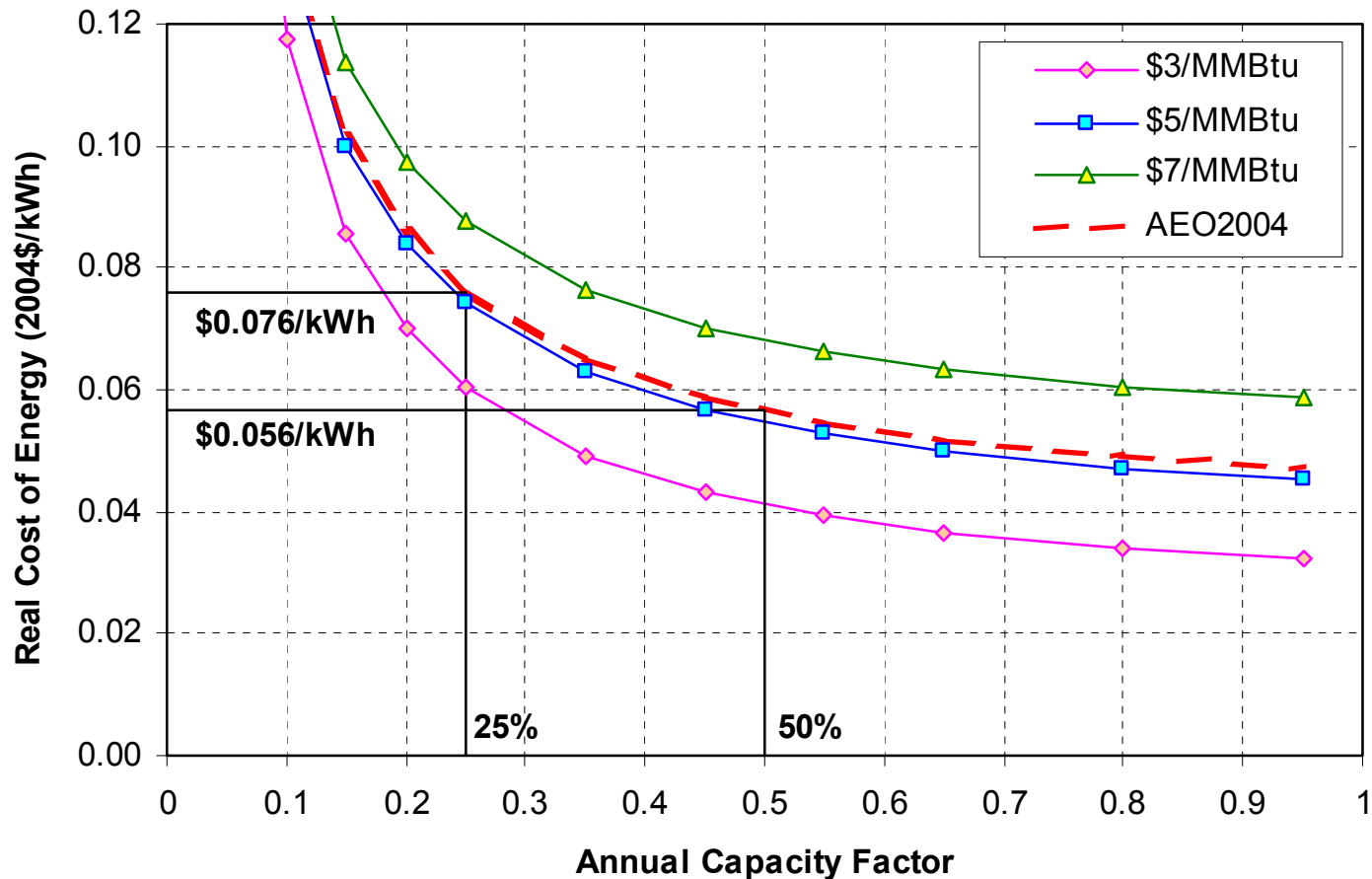


Influence of Natural Gas Price on the Cost of Electricity

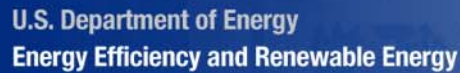




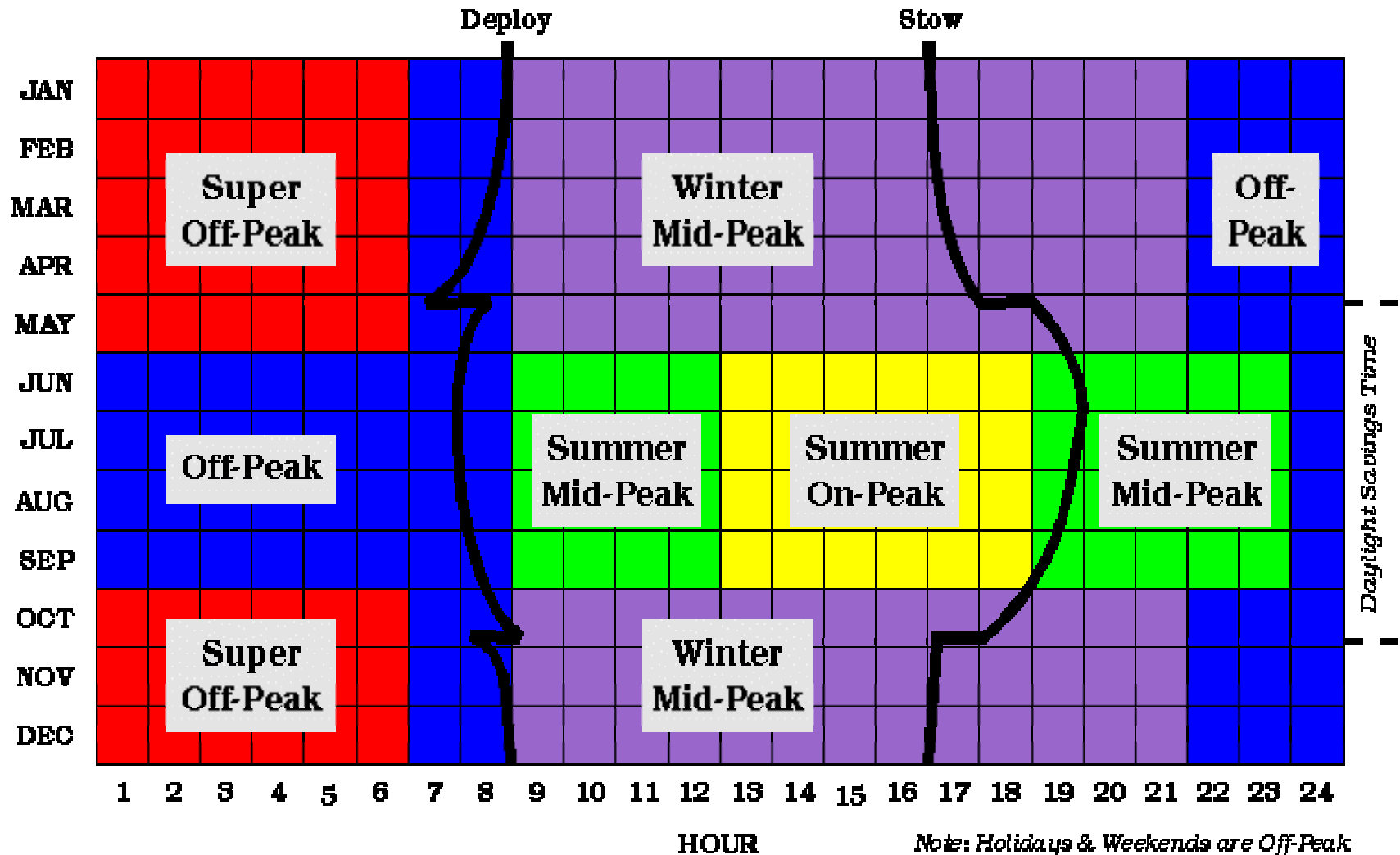
Solar Generation Cost Targets



Note: 1.0 MMBtu = 1.055 GJ



Southern California Edison Time Of Use Periods

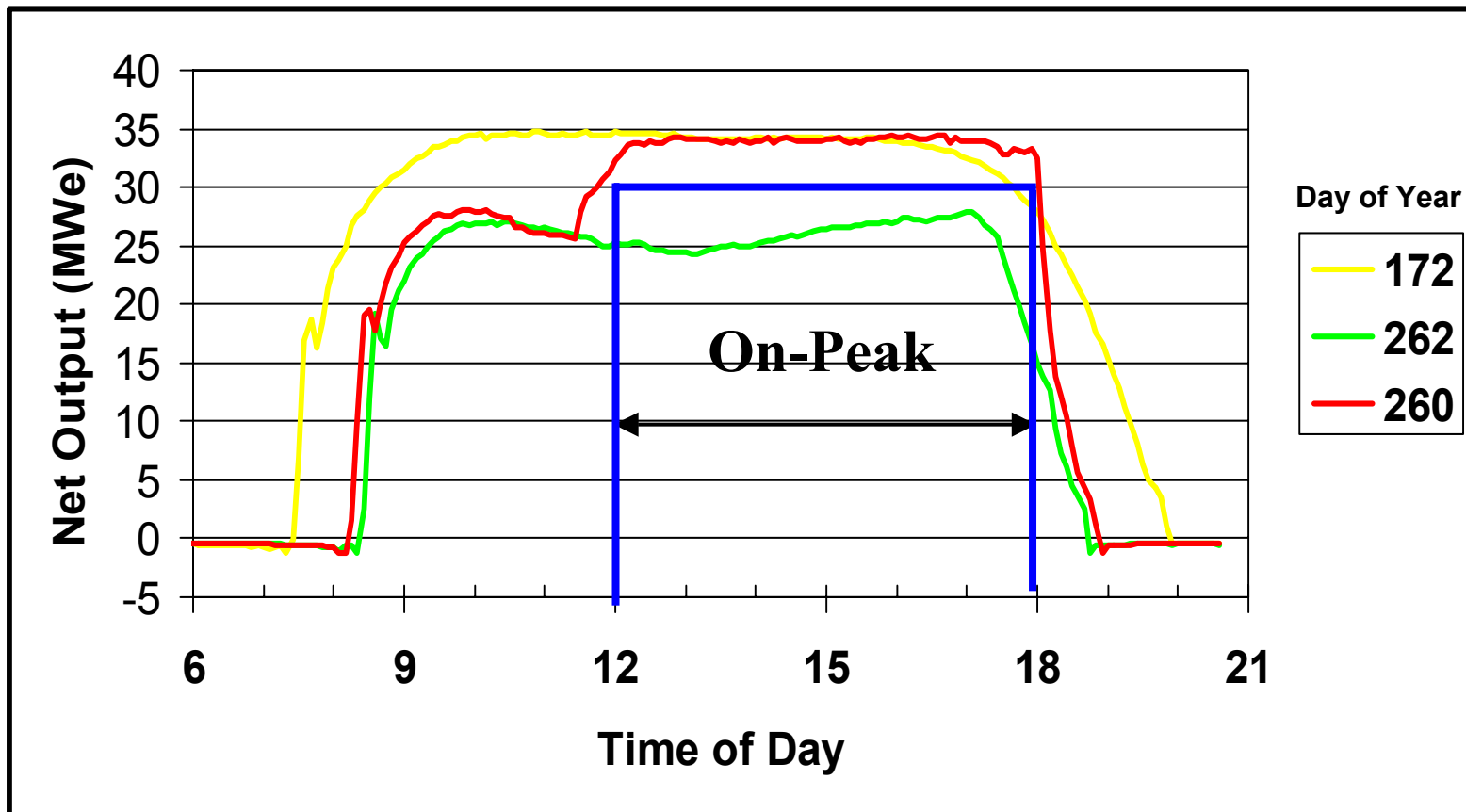




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Solar/Hybrid Plant

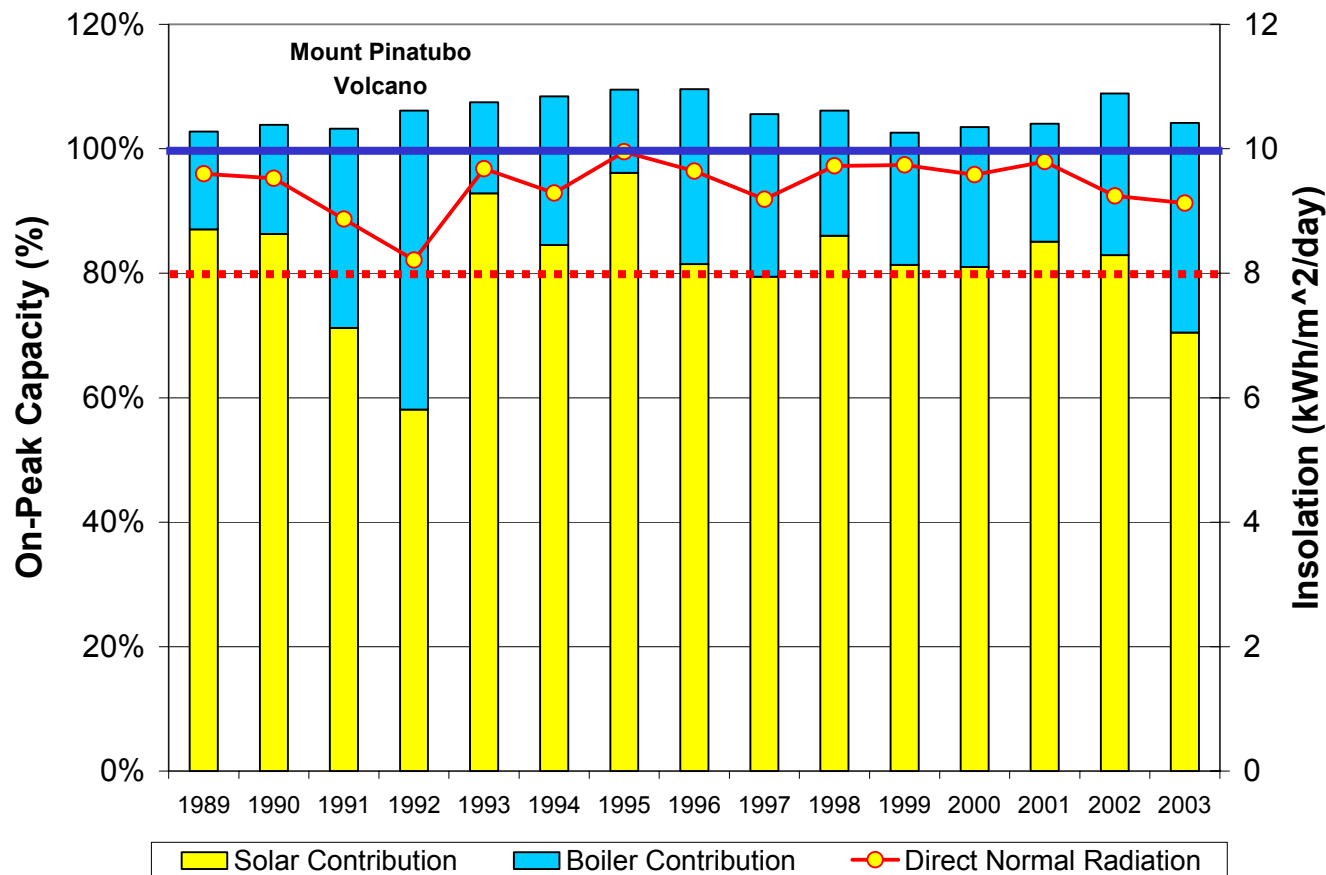
30 MW SEGS Plant Output





Do Solar Plants Deserve Full Capacity Payment?

SEGS III - VII On-Peak Performance



**SCE Summer
On-Peak
Jun - Sep
Weekdays
12 noon - 6 pm**

**Firm Capacity
Requirement
Minimum of
80% capacity Factor
During On-Peak**



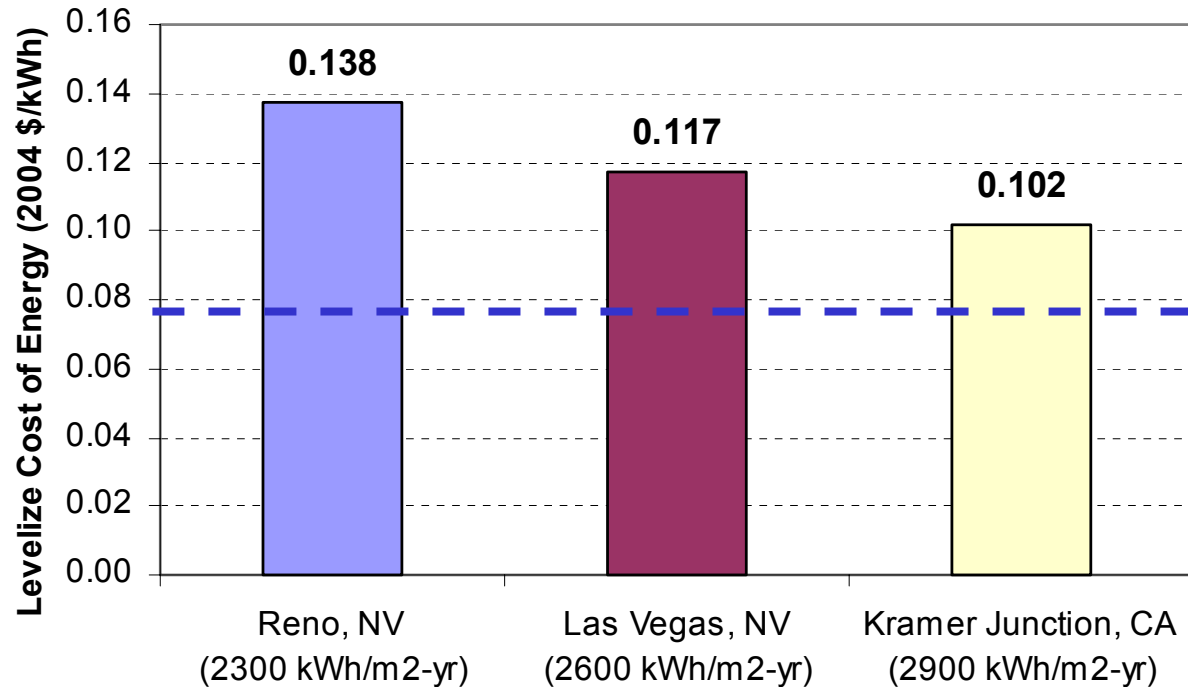
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Cost of Solar Electricity from Parabolic Trough Plants





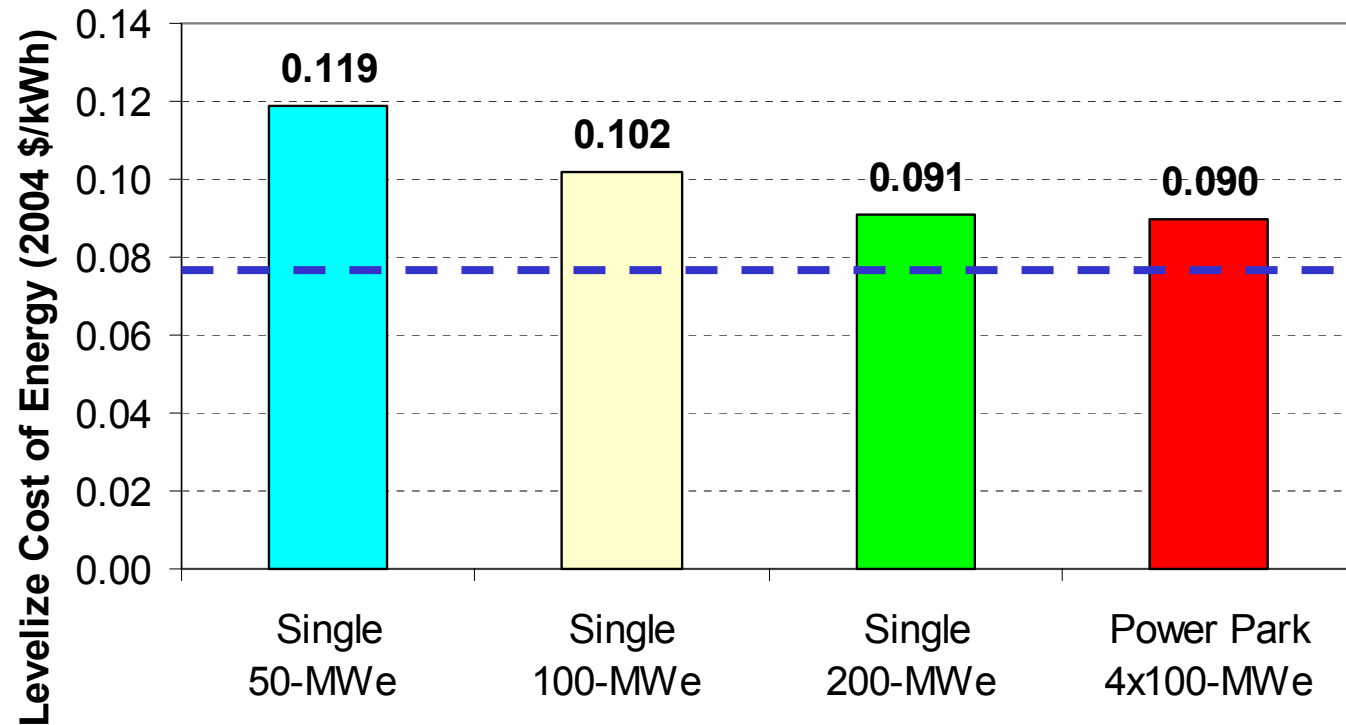
Cost of Electricity



Reference Trough Plant
100 MWe
Solar Only
Current Solar Technology

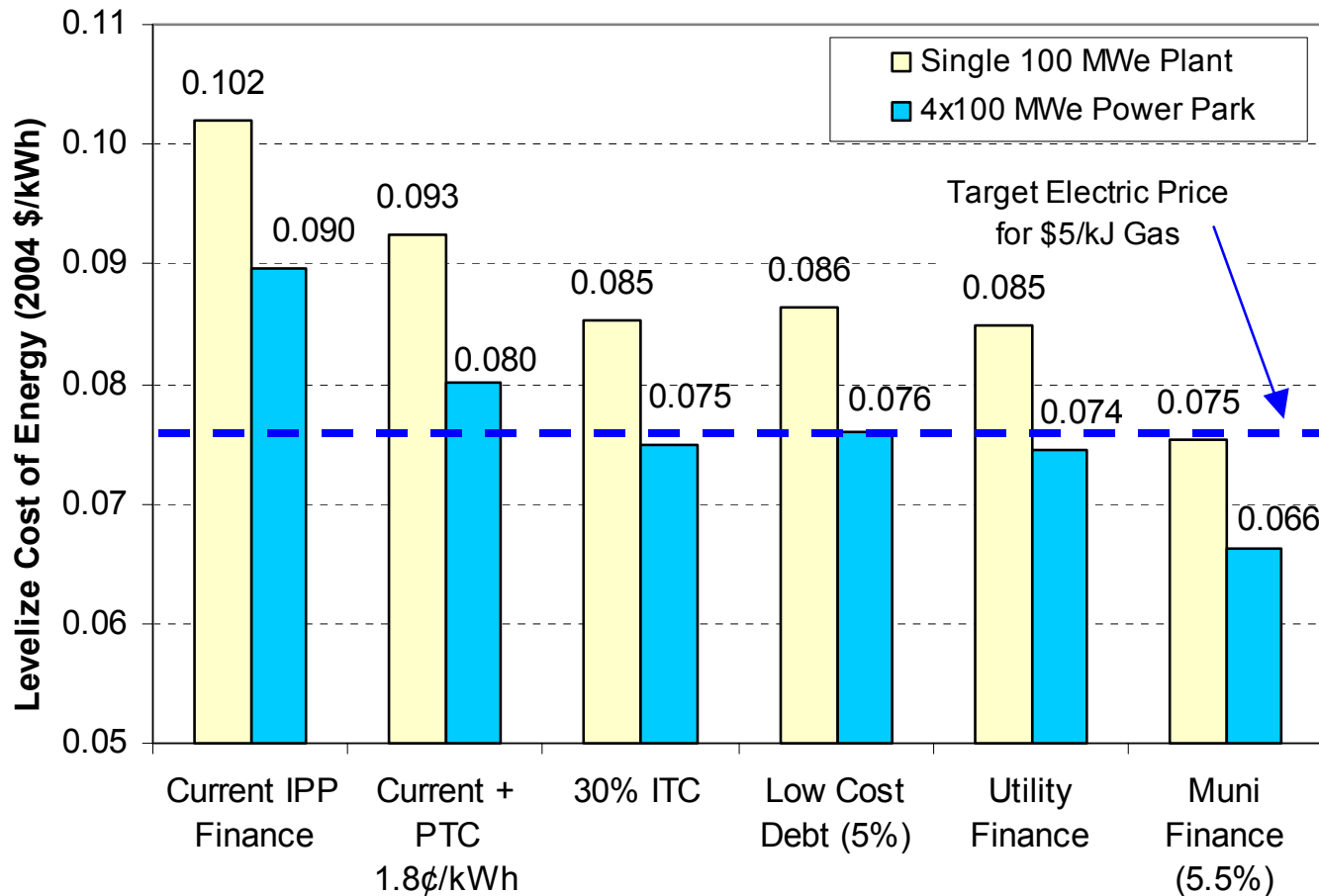


Cost of Trough Electricity as a Function of Plant Size





Influence of Financial Incentives on the Cost of Electricity





Market Conclusions

- **Natural gas is the marginal fuel and defines the value of electricity in the Southwest**
- **Trough plants have demonstrated the ability of solar electricity to meet utility firm capacity requirements**
- **Trough technology is close to competitive with conventional power sources at today's natural gas prices**
- **Additional financial incentives, access to lower cost financing, or renewable market portfolio standards are needed to accelerate development of trough power in the Southwest.**